INSTITUTO AGRONÔMICO DE CAMPINAS
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STALK YIELD AND NITROGEN EXPORTS AFTER NITROGEN FERTILIZATION OF TWO SUGARCANE RATOONS

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INTRODUCTION

Sugarcane: More than 8.5 million ha in Brazil
→ 60% in São Paulo state

Nitrogen use in sugarcane: Almost 20% of total energy spent for bioethanol production

Brazil: Lower rates than other countries
→ Energy economy

INTRODUCTION

Brazil: Lower nitrogen rates than other countries

Brazil → 57.6 kg N ha^{-1} yr^{-1} → 3060 MJ ha^{-1} yr^{-1}

Other countries → 150 kg N ha^{-1} yr^{-1} → 8100 MJ ha^{-1} yr^{-1}

2.6x

Source: Boddey et al., 2008

Other sources of Nitrogen???

Contribution of Biological Nitrogen Fixation (BNF) in sugarcane

→ About 40% (Herridge et al., 2008)

INTRODUCTION

Doubts about Nitrogen management in sugarcane

- ✓Plant-cane ↔ Ratoon-cane
- ✓Burned and Unburned litter management systems

- N exports *vs.* N addition from fertilizers

→ **Exports higher than addition** → **Could it be sustainable in long-term?**

INTRODUCTION

Sugarcane fields

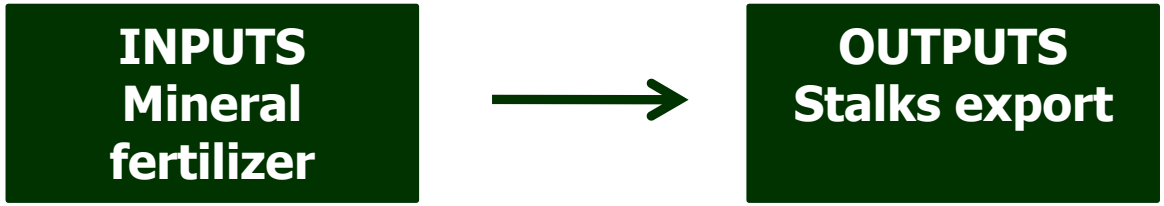
GOALS:
Biomass production and longevity
High yields for several cycles

High Nitrogen requirement → **N surplus: Environmental effects**

Lack of long-term studies: Several cycles under contrasting management situations

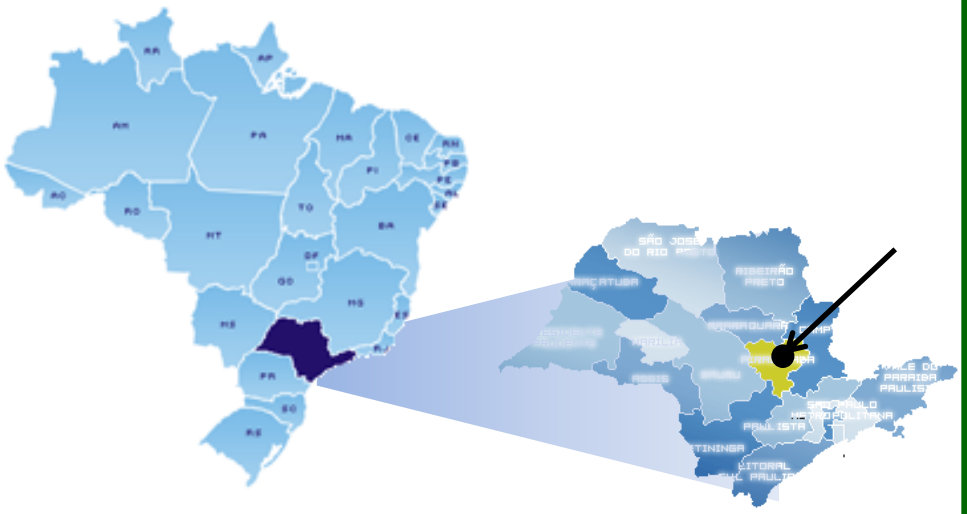
OBJECTIVE

- Assess the N uptake, export of N, stalk yield and nitrogen balance in 2 consecutive ratoons of sugarcane



METHODOLOGY

Experimental area
Place: Piracicaba/SP
Typic Alfisol (Nitossolo Háplico)



Experiment establishment

→ Sugarcane planted: <u>March 2007</u>

→ Variety: IAC 92-1099

→ Fertilization: 48 kg N ha^{-1}; 75 kg P ha^{-1}; 80 kg K ha^{-1}

→ High stalk yield in the 1st cycle harvest (213 t ha^{-1})

METHODOLOGY

→ Treatments applied after harvest of plant-cane (Sep. 2008 and Sep. 2009)

- 0 kg N ha^{-1}
- 60 kg N ha^{-1}
- 120 kg N ha^{-1}
- 180 kg N ha^{-1}

Ammonium nitrate

Accumulated rates
0 kg ha^{-1}
120 kg ha^{-1}
240 kg ha^{-1}
360 kg ha^{-1}

❑ Experimental Design

→ Randomized complete blocks, 4 replications

❑ Evaluations

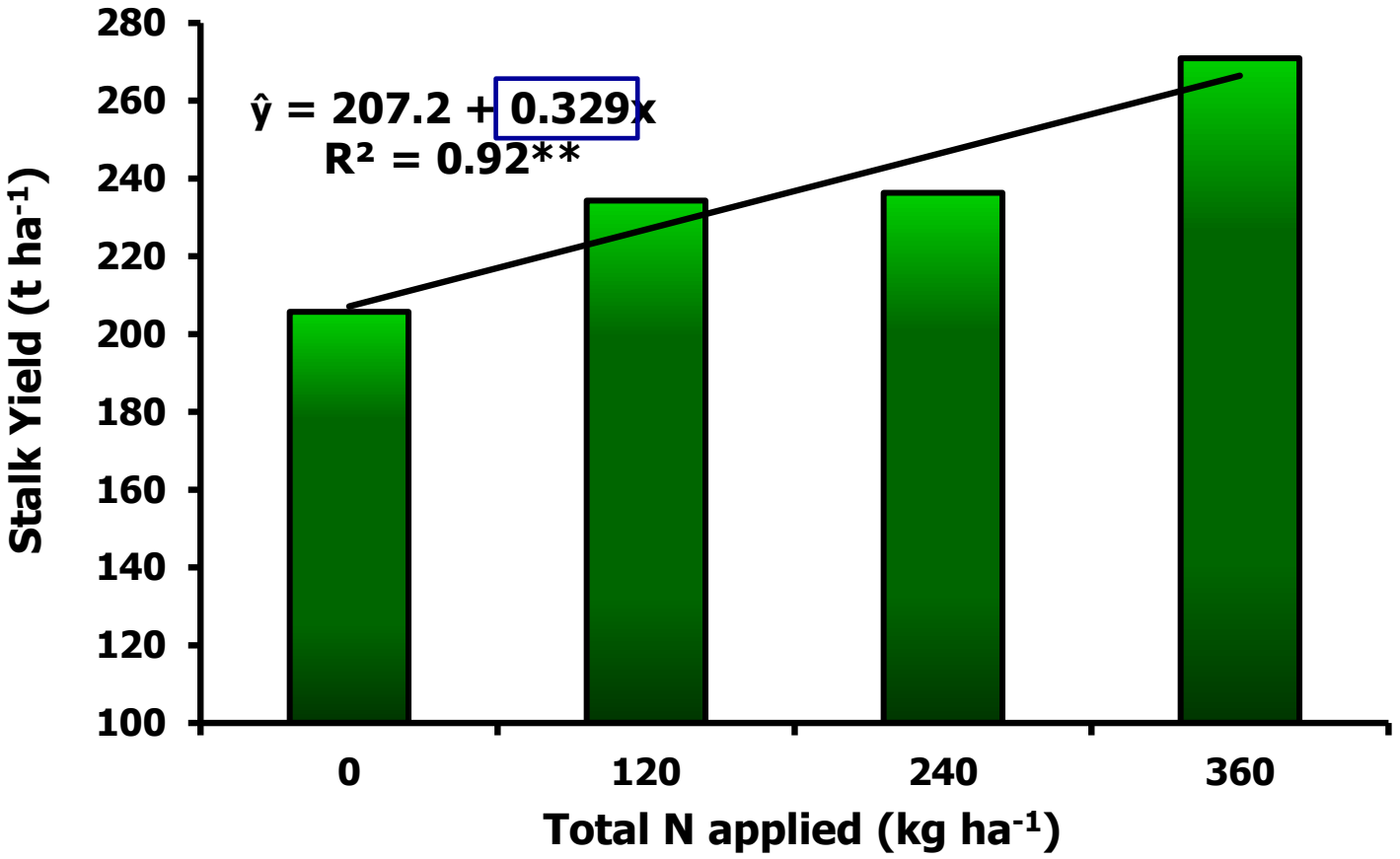
→ Stalk yields

→ N uptake and N export

→ Nitrogen balance

RESULTS

Stalk Yield (Sum of 2 ratoons)



RESULTS

Energy Balance

330 kg of stalks for each kg of N fertilizer → 81 L of alcohol for each ton of stalks

27 L of ethanol for each kg of N applied – Total: 9720 L of alcohol in the higher rate

Energy spend (Boddey et al., 2008)

→ N fertilizer: 54 MJ/kg

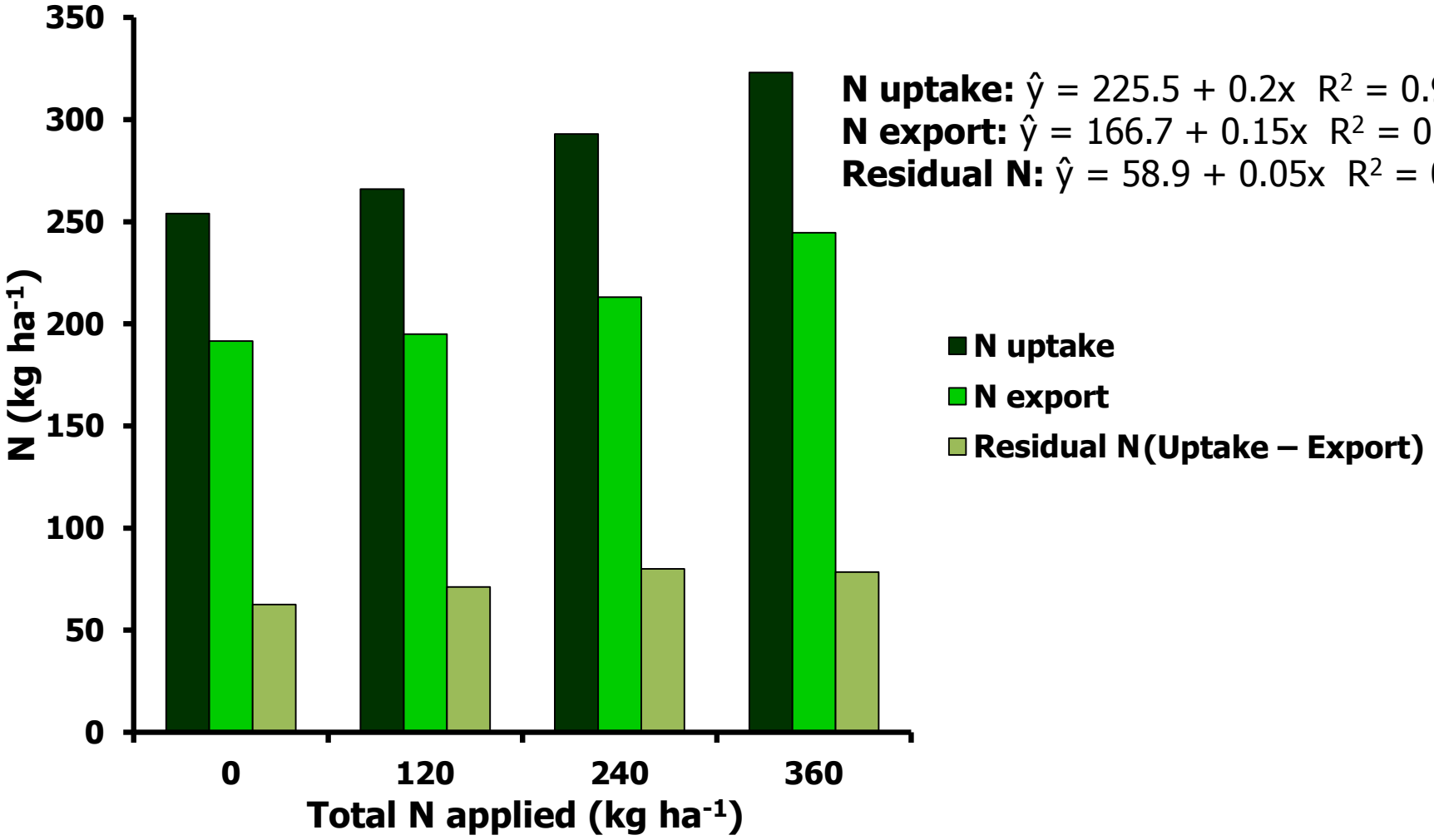
→ Ethanol: 21.5 MJ/L

- ✓ Increase in the bioethanol production: 9720 L with 360 kg N ha^{-1}
- ✓ Ethanol: 9720L x 21.5 MJ = **208980 MJ**
- ✓ Fertilizer: 54 MJ/kg x 360 kg = **7740 MJ**

} **27 x**

RESULTS

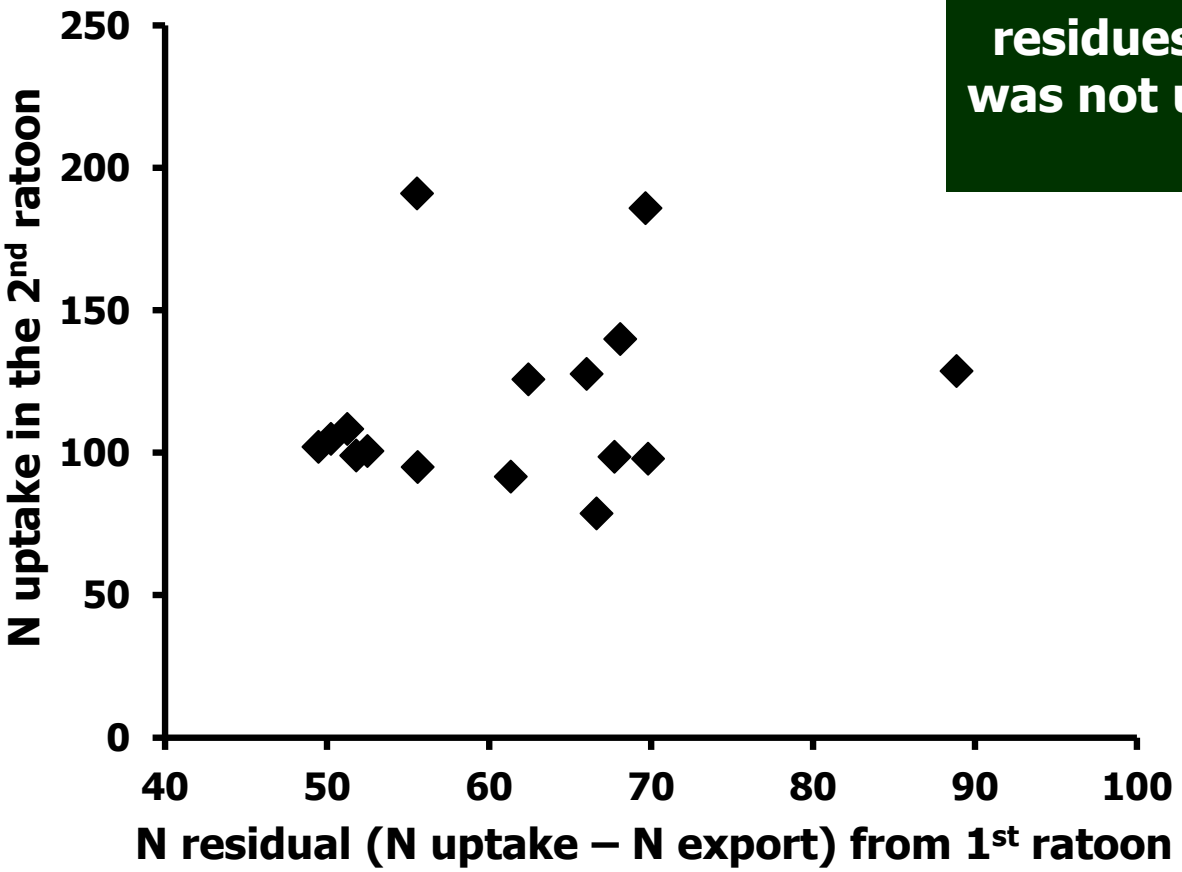
Total N uptake (Sum of 2 ratoons)



RESULTS

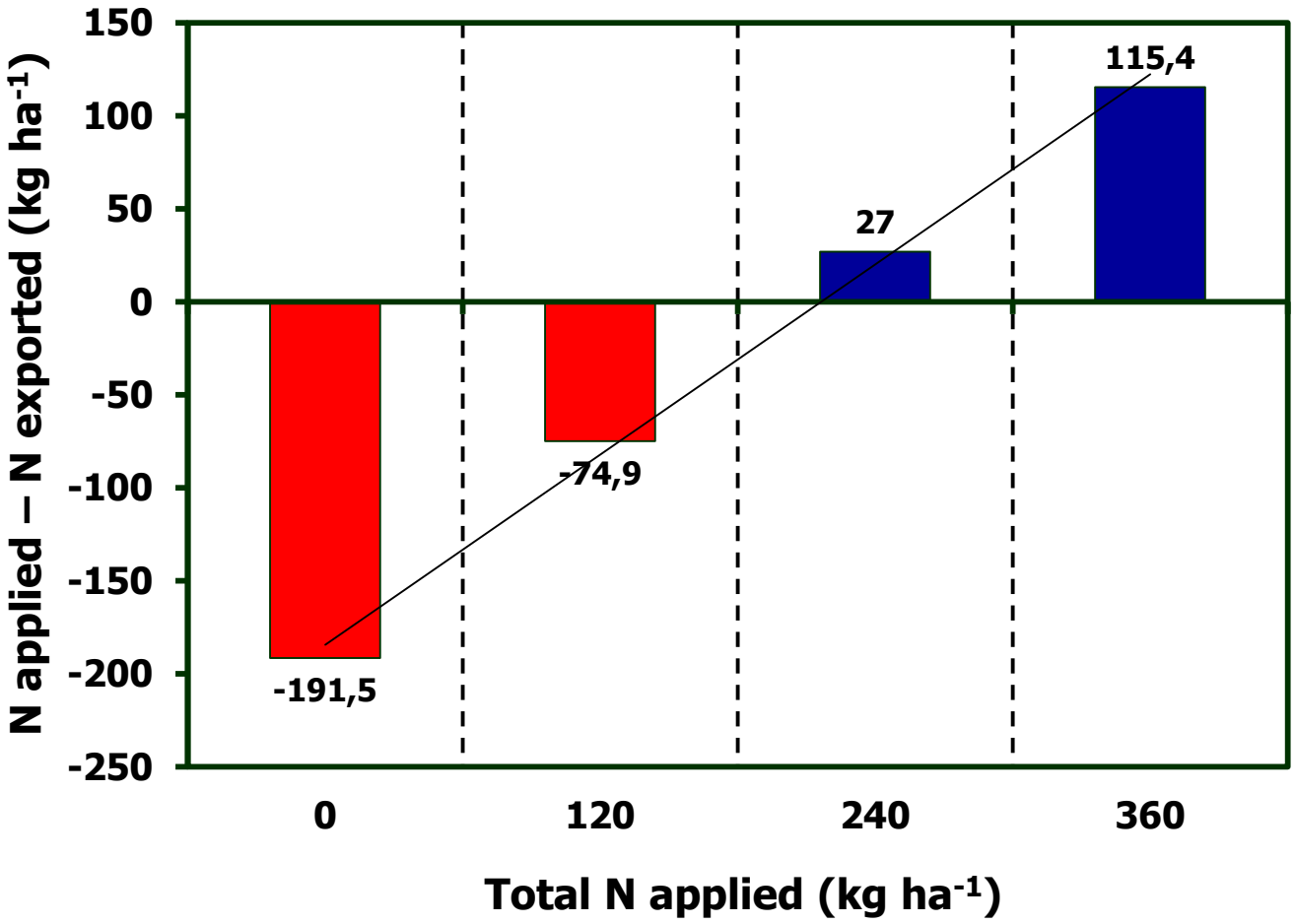
N residual from 1st ratoon X N uptake in the 2nd ratoon

N contained in plant residues from 1st ratoon was not used by following ratoon



RESULTS

Inputs (Mineral fertilizer) – Outputs (N exports by stalks)



≅140 kg ha^{-1} ratoon^{-1}

$\hat{y} = 286.7 + 102.3x$

$R^2 = 0.99^{**}$

RESULTS

- Control treatment (without N)
  - Total N uptake: 254 kg ha^{-1}

- Large amounts of N supplied by soil
- BNF???

- 60 kg ha^{-1} $ratoon^{-1}$
  - Total N uptake: 266 kg ha^{-1}

  266 kg ha^{-1} – 254 kg ha^{-1} (control) = 12 kg ha^{-1}

- 120 kg ha^{-1} $ratoon^{-1}$
  - Total N uptake: 293 kg ha^{-1}

  293 kg ha^{-1} – 254 kg ha^{-1} = 39 kg ha^{-1}

- 180 kg ha^{-1} $ratoon^{-1}$
  - Total N uptake: 323 kg ha^{-1} – 254 kg ha^{-1} = 69 kg ha^{-1}

CONCLUSIONS

- The ratoon cane is highly responsive to nitrogen fertilization and reaches high yield levels with high N rates. However, high N rates might result in N surplus.

- The common recommendation of 90-120 kg ha^{-1} of N on sugarcane ratoons may cause negative balance of N in many situations.

CONCLUSIONS

- Studies are necessary to assess long-term effect of fertilizer management on yield and quality of sugarcane and its impact on soil fertility.

This study will continue for at least two more cycles in order to address these questions.


IAC
Thank You!